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KARTU KONSULTASI TUGAS AKHIR

Nama	: Beny Al Fattah	Pembimbing	: Ir. Renaningsih, M.T.
No Induk	: D 100 110 102	Penguji I	: Agus Susanto, S.T., M.T.
		Penguji II	: Senja Rum Harnaeni, S.T., M.T.
NIRM	:	Tgl. dimulai	: .....
Jurusan/Progdi	: Teknik Sipil	Tgl. selesai	: .....

Judul/Topik : REVIEW ON THE SHEAR STRENGTH OF CLAY SUBDISTRICT OF SUKODONO SRAGEN DISTRICT WITH THE ADDITIONAL STABILITATION MATERIAL THE POWDWER OF WOOD CHARCOAL

NO.	TANGGAL	MATERI KONSULTASI	T. TANGAN*
	17-7-17	Acc revisi TA.	
	18/7-2017	Acc revisi	
	18/7/2017	ACC REVISI	

Catatan : - Harap dibawa setiap konsultasi

*** Pembimbing Tugas Akhir**

Mengetahui : **Surakarta, ...2017**

Ketua Program Studi **Mahasiswa,**

Mochamad Solikhin, S.T., M.T., Ph.D. **Beny Al Fattah.**

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KARTU KONSULTASI TUGAS AKHIR

Nama : Beny Al Fattah

No Induk : D 100 110 102

NIRM : .....

Jurusan/Progdi : Teknik Sipil

Pembimbing I : Ir. Renaningsih, M.T.

Tgl. dimulai : .....

Tgl. selesai : .....

Judul/Topik : REVIEW ON THE SHEAR STRENGTH OF CLAY SUBDISTRICT OF SUKODONO SRAGEN DISTRICT WITH THE ADDITIONAL STABILITATION MATERIAL THE POWDWER OF WOOD CHARCOAL

NO.	TANGGAL	MATERI KONSULTASI	T. TANGAN*
4	31/5 - 2017	- Bahasan lolos # 200 perbaiki (grafik) - Kesimpulan menjawab tujuan	
5	2/6 - 2017	- Data tabel tambah ditampilkan - Lengkapi laporan	
6	6/6	- Acc, bisa seminar pra	

Catatan : - Harap dibawa setiap konsultasi

*** Pembimbing Tugas Akhir**

Mengetahui : **Surakarta, ...2017**

Ketua Program Studi **Mahasiswa,**

Mochamad Solikhin, S.T., M.T., Ph.D. **Beny Al Fattah.**

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FAKULTAS TEKNIK

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KARTU KONSULTASI TUGAS AKHIR

Nama : Beny Al Fattah
Pembimbing I : Ir. Renaningsih, M.T.

No Induk : D 100 110 102

NIRM : .....
Tgl. dimulai : .....

Jurusan/Progdi : Teknik Sipil
Tgl. selesai : .....

Judul/Topik : REVIEW ON THE SHEAR STRENGTH OF CLAY SUBDISTRICT OF SUKODONO SRAGEN DISTRICT WITH THE ADDITIONAL STABILITATION MATERIAL THE POWDWER OF WOOD CHARCOAL

NO.	TANGGAL	MATERI KONSULTASI	T. TANGAN*
1	11/4-2017	- Perbaiki hitungan LL - Perbaiki hasil Ø dr DST sesuaikan hasil dg gambar - uji kadar air tanah asli ?	
2	5/4-2017	- check w kering udara - check lagi klasifikasi tanah nya. - buat grafik 20 lolos 200 & 20 γ_d, w_{opt} & thn stabilisasi'	20 thn stabilisasi'
3	24/5-2017	- Add keterangan kenapa terjadi kenaikan / penurunan hasil T	

Catatan : - Harap dibawa setiap konsultasi

*** Pembimbing Tugas Akhir**

Mengetahui : **Surakarta, ...2017**

Ketua Program Studi **Mahasiswa,**

Mochamad Solikhin, S.T., M.T., Ph.D. **Beny Al Fattah.**

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Appendix A.1

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil

WATER CONTENT

(*MOISTURE CONTENT*)

	Sample		Number		
A	Cup Number		1	2	3
B	Cup Weight	(gr)	98,00	47,00	82,00
C	Cup Weight + Wet Soil	(gr)	244,00	197,00	232,00
D	Weight Cup + Dry Soil	(gr)	220,00	174,00	210,00
E	Water Weight	(gr)	24,00	23,00	22,00
F	Dry Weight of Sample	(gr)	122,00	127,00	128,00
G	Water Content	(%)	19,67	18,11	17,19
H	Average	(%)	18,323		

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Appendix A.2

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 10%

WATER CONTENT

(*MOISTURE CONTENT*)

	Sample		Number	
A	Cup Number		1	2
B	Cup Weight	(gr)	11,00	11,00
C	Cup Weight + Wet Soil	(gr)	29,75	27,49
D	Weight Cup + Dry Soil	(gr)	25,93	24,15
E	Water Weight	(gr)	3,82	3,34
F	Dry Weight of Sample	(gr)	14,93	13,15
G	Water Content	(%)	25,59	25,40
H	Average	(%)	25,493	

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Appendix A.3

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 15%

WATER CONTENT

(*MOISTURE CONTENT*)

	Sample		Number	
A	Cup Number		1	2
B	Cup Weight	(gr)	11,00	11,00
C	Cup Weight + Wet Soil	(gr)	26,42	24,75
D	Weight Cup + Dry Soil	(gr)	23,57	22,10
E	Water Weight	(gr)	2,85	2,65
F	Dry Weight of Sample	(gr)	12,57	11,10
G	Water Content	(%)	22,67	23,87
H	Average	(%)	23,273	

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Appendix A.4

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 20%

WATER CONTENT

(*MOISTURE CONTENT*)

	Sample		Number	
A	Cup Number		1	2
B	Cup Weight	(gr)	11,00	11,00
C	Cup Weight + Wet Soil	(gr)	48,31	48,56
D	Weight Cup + Dry Soil	(gr)	41,89	41,89
E	Water Weight	(gr)	6,42	6,67
F	Dry Weight of Sample	(gr)	30,89	30,89
G	Water Content	(%)	20,78	21,59
H	Average	(%)	21,188	

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Appendix B.1

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil

SPECIFIC GRAVITY
SK-SNI-04-1989-F

Sample		Number	
Picnometer Number		1	2
Picnometer Weight + Soil	W1	100,47	101,36
Picnometer Weight	W2	55,47	56,36
Soil Weight	WT = W1 - W2	45	45
Temperature		28	28
Picnometer + Water + Soil	W3	182,36	182,25
Picnometer+ Water on °C	W4	154,61	154,34
(W1 - W2) + W4	W5	199,61	199,34
Soil	(W5-W3)	17,25	17,09
Specific Gravity	WT/(W5-W3)	2,609	2,633
Average		2,621	

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Appendix B.2

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 10%

SPECIFIC GRAVITY
SK-SNI-04-1989-F

Sample		Number	
Picnometer Number		1	2
Picnometer Weight + Soil	W1	259	248
Picnometer Weight	W2	165	152
Soil Weight	WT = W1 - W2	94	96
Temperature		28	28
Picnometer + Water + Soil	W3	719	708
Picnometer+ Water on °C	W4	663	651
(W1 - W2) + W4	W5	757	747
Soil	(W5-W3)	38	39
Specific Gravity	WT/(W5-W3)	2,474	2,462
Average		2,468	

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Appendix B.3

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 15%

SPECIFIC GRAVITY
SK-SNI-04-1989-F

Sample		Number	
Picnometer Number		1	2
Picnometer Weight + Soil	W1	262	241
Picnometer Weight	W2	165	152
Soil Weight	WT = W1 - W2	97	89
Temperature		28	28
Picnometer + Water + Soil	W3	716	702
Picnometer+ Water on °C	W4	659	650
(W1 - W2) + W4	W5	756	739
Soil	(W5-W3)	40	37
Specific Gravity	WT/(W5-W3)	2,431	2,425
Average		2,428	

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Appendix B.4

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 20%

SPECIFIC GRAVITY
SK-SNI-04-1989-F

Sample		Number	
Picnometer Number		1	2
Picnometer Weight + Soil	W1	270	258
Picnometer Weight	W2	165	152
Soil Weight	WT = W1 - W2	105	106
Temperature		28	28
Picnometer + Water + Soil	W3	732	722
Picnometer+ Water on °C	W4	671	660
(W1 - W2) + W4	W5	776	766
Soil	(W5-W3)	44	44
Specific Gravity	WT/(W5-W3)	2,403	2,409
Average		2,406	

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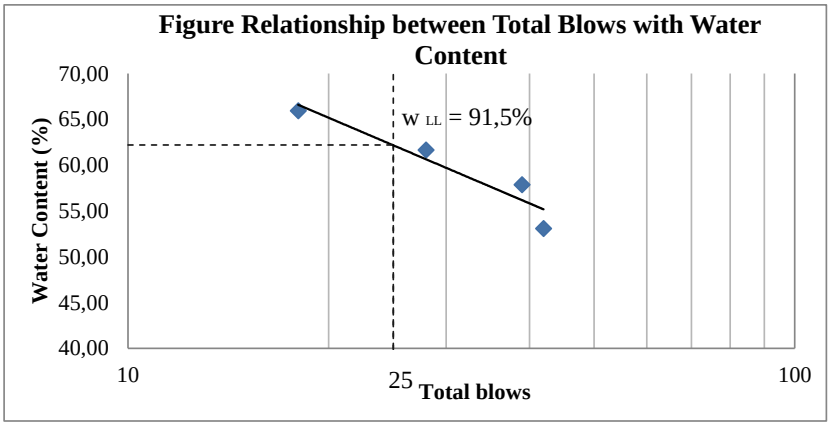
Appendix C.1

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil

ATTERBERG LIMIT

	Total Blows		LIQUID LIMIT (LL)				PLASTIC LIMIT	
			16	29	37	49	PL	
A	Cup Number		1	2	3	4	1	2
B	Cup Weight	gr	3,87	4,28	3,76	3,95	3,88	3,82
C	Cup Weight + Wet Soil	gr	7,74	7,37	11,48	8,5	4,2	4,11
D	Cup Weight + Dry Soil	gr	5,87	5,89	7,82	6,37	4,13	4,05
E	Water Weight = C - D	gr	1,87	1,48	3,66	2,13	0,07	0,06
F	Dry Weight Soil = D - B	gr	2	1,61	4,06	2,42	0,25	0,23
G	Water Content = (E/F) x 100%	%	93,50	91,93	90,15	88,02	28,00	26,09
H	Average	%					27,04	



Batas Susut SL				
A	Cup Number		1	2
B	Cup Weight	gr	3,78	3,87
C	Cup Weight + Wet Soil	gr	26,7	26,65
D	Cup Weight + Dry Soil	gr	17,09	17,02
E	Water Weight = C - D	gr	9,61	9,63
F	Dry Weight Soil = D - B	gr	13,31	13,15
G	Water Content = (E/F) x 100%	%	72,20	73,23
H	Wet Soil (V)	ml	15,25	15,25
I	Dry Soil (Vo)	ml	7,14	7,11
J	Shrinkage Limit (SL) = G-((H-I)/F)X100%	%	11,27	11,33
	Average	%	11,30	

LL %	PL %	PI %	SL %
91,50	27,04	64,46	11,30

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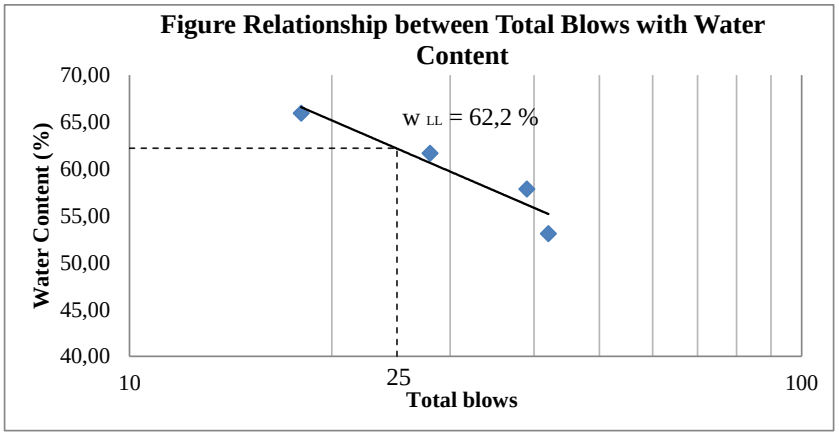
Appendix C.2

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 10%

ATTERBERG LIMIT

	Total Blows		LIQUID LIMIT (LL)				PLASTIC LIMIT	
			18	28	39	42	(PL)	
A	Cup Number		1	2	3	4	1	2
B	Cup Weight	gr	10,11	10,09	11,01	10,28	3,79	3,73
C	Cup Weight + Wet Soil	gr	17,03	15,91	16,63	14,23	4,08	4,12
D	Cup Weight + Dry Soil	gr	14,28	13,69	14,57	12,86	4,02	4,04
E	Water Weight = C - D	gr	2,75	2,22	2,06	1,37	0,06	0,08
F	Dry Weight Soil = D - B	gr	4,17	3,6	3,56	2,58	0,23	0,31
G	Water Content = (E/F) x 100%	%	65,95	61,67	57,87	53,10	26,09	25,81
H	Average	%					25,95	



SHRINKAGE LIMIT				
A	Cup Number		1	2
B	Cup Weight	gr	10,19	37,48
C	Cup Weight + Wet Soil	gr	33,35	53,16
D	Cup Weight + Dry Soil	gr	22,04	42,82
E	Water Weight = C - D	gr	11,31	10,34
F	Dry Weight Soil = D - B	gr	11,85	5,34
G	Water Content = (E/F) x 100%	%	95,44	193,63
H	Wet Soil (V)	ml	17,5	20,5
I	Dry Soil (Vo)	ml	7,3	10,69
J	Shrinkage Limit (SL) = G-((H-I)/F)X100%	%	9,37	9,93
	Average	%	9,65	

LL %	PL %	PI %	SL %
62,20	25,95	36,25	9,65

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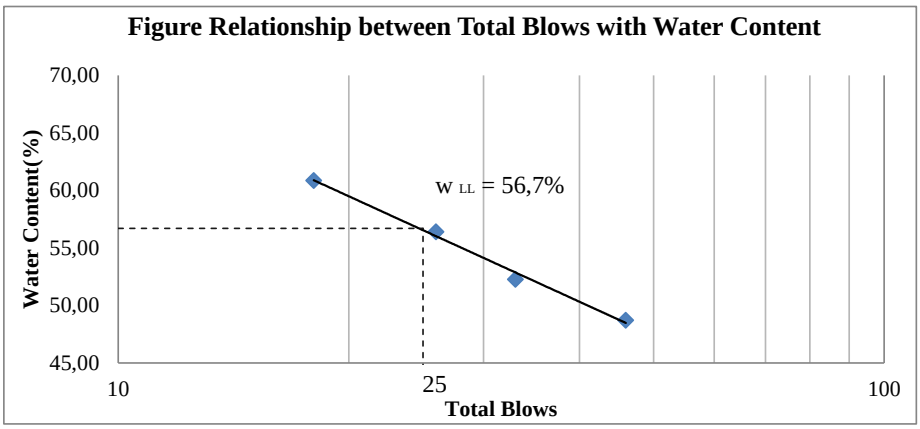
Appendix C.3

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 15%

ATTERBERG LIMIT

	Total Blows		LIQUID LIMIT (LL)				PLASTIC LIMIT	
			18	26	33	46	PL	
A	Cup Number		1	2	3	4	1	2
B	Cup Weight	gr	3,43	3,79	3,33	3,72	3,72	3,75
C	Cup Weight + Wet Soil	gr	9,43	10,25	9,36	8,91	4,09	4,15
D	Cup Weight + Dry Soil	gr	7,16	7,92	7,29	7,21	4,01	4,06
E	Water Weight = C - D	gr	2,27	2,33	2,07	1,7	0,08	0,09
F	Dry Weight Soil = D - B	gr	3,73	4,13	3,96	3,49	0,29	0,31
G	Water Content = (E/F) x 100%	%	60,86	56,42	52,27	48,71	27,59	29,03
H	Average	%					28,31	



SHRINKAGE LIMIT				
A	Cup Number		1	2
B	Cup Weight	gr	10,20	11,05
C	Cup Weight + Wet Soil	gr	32,97	52,57
D	Cup Weight + Dry Soil	gr	22,05	40,33
E	Water Weight = C - D	gr	10,92	12,24
F	Dry Weight Soil = D - B	gr	11,85	29,28
G	Water Content = (E/F) x 100%	%	92,15	41,80
H	Wet Soil (V)	ml	17,5	20,5
I	Dry Soil (Vo)	ml	7,3	10,2
J	Shrinkage Limit (SL) = G-((H-I)/F)X100%	%	6,08	6,63
	Average	%	6,35	

LL %	PL %	PI %	SL %
56,70	28,31	28,39	6,35

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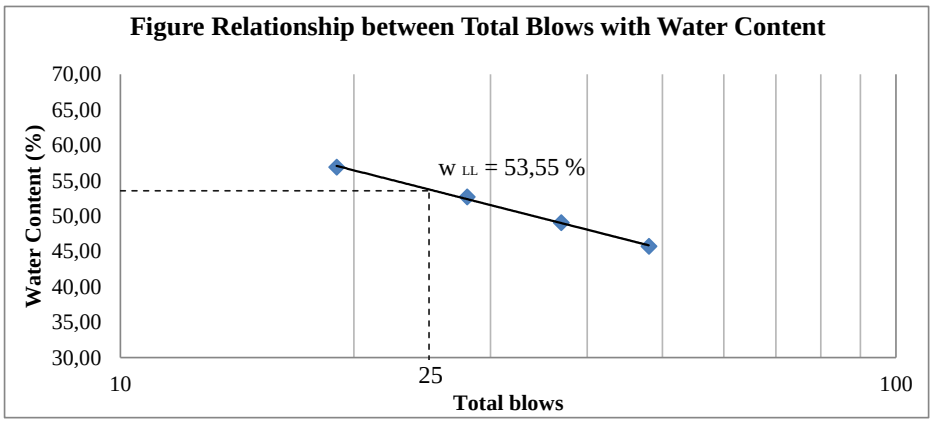
Appendix C.4

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 20%

ATTERBERG LIMIT

	Total Blows		LIQUID LIMIT (LL)				PLASTIC LIMIT	
			19	28	37	48	PL	
A	Cup Number		1	2	3	4	1	2
B	Cup Weight	gr	3,41	3,89	3,36	3,73	3,70	3,72
C	Cup Weight + Wet Soil	gr	8,32	7,86	7,95	6,44	4,10	4,45
D	Cup Weight + Dry Soil	gr	6,54	6,49	6,44	5,59	4,01	4,28
E	Water Weight = C - D	gr	1,78	1,37	1,51	0,85	0,10	0,18
F	Dry Weight Soil = D - B	gr	3,13	2,6	3,08	1,86	0,30	0,55
G	Water Content = (E/F) x 100%	%	56,87	52,69	49,03	45,70	31,68	31,65
H	Average	%					31,66	



SHRINKAGE LIMIT				
A	Cup Number		1	2
B	Cup Weight	gr	8,57	8,92
C	Cup Weight + Wet Soil	gr	36,26	38,63
D	Cup Weight + Dry Soil	gr	26,11	28,03
E	Water Weight = C - D	gr	10,15	10,6
F	Dry Weight Soil = D - B	gr	17,54	19,11
G	Water Content = (E/F) x 100%	%	57,87	55,47
H	Wet Soil (V)	ml	19	20,5
I	Dry Soil (Vo)	ml	9,6	10,8
J	Shrinkage Limit (SL) = G-((H-I)/F)X100%	%	4,28	4,71
	Average	%	4,49	

LL %	PL %	PI %	SL %
53,55	31,66	21,89	4,49

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Appendix D.1

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil

SIEVE ANALYSIS

Dry weight soil : 100 gr

Sieve Number	Sieve Weight (gr)	Sieve Weight + Soil (gr)	Soil Weight (gr)	∑ Soil Weight (gr)	Persentage	
					Detained %	Through %
	-	-	-	-	-	-
3/4	418	418	0	0	0	100
3/8	380	380	0	0	0	100
4	380	380	0	0	0	100
8	426	427,2	1,2	1,2	1	99
16	358	358,99	0,99	2,19	2	98
30	335	335,99	0,99	3,18	3	97
50	293	294	1	4,18	4	96
100	389	391,89	2,89	7,07	7	93
200	287	288,34	1,34	8,41	8	91
pan	375	466,59	91,59	100	100	0
			100			

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Appendix D.2

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 10%

SIEVE ANALYSIS

Dry weight soil : 100 gr

Sieve Number	Sieve Weight (gr)	Sieve Weight + Soil (gr)	Soil Weight (gr)	∑ Soil Weight (gr)	Persentage	
					Detained %	Through %
	-	-	-	-	-	-
3/4	418	418	0	0	0	100
3/8	380	380	0	0	0	100
4	380	380	0	0	0	100
8	426	426,11	0,11	0,11	0	100
16	358	358,72	0,72	0,83	1	99
30	335	335,85	0,85	1,68	2	98
50	293	293,93	0,93	2,61	3	97
100	389	393,37	4,37	6,98	7	93
200	287	289,98	2,98	9,96	10	91
pan	375	465,04	90,04	100	100	0
			100			

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Appendix D.3

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 15%

SIEVE ANALYSIS

Dry weight soil : 100 gr

Sieve Number	Sieve Weight (gr)	Sieve Weight + Soil (gr)	Soil Weight (gr)	∑ Soil Weight (gr)	Persentage	
					Detained %	Through %
	-	-	-	-	-	-
3/4	418	418	0	0	0	100
3/8	380	380	0	0	0	100
4	440	440	0	0	0	100
8	434	434,32	0,32	0,32	0	100
16	358	358	0	0,32	0	100
30	401	402,03	1,03	1,35	1	99
50	293	293,71	0,71	2,06	2	98
100	390	393,73	3,73	5,79	6	94
200	288	292,69	4,69	10,48	10	90
pan	252	341,52	89,52	100	100	0
			100			

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Appendix D.4

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 20%

SIEVE ANALYSIS

Dry weight soil : 100 gr

Sieve Number	Sieve Weight (gr)	Sieve Weight + Soil (gr)	Soil Weight (gr)	∑ Soil Weight (gr)	Persentage	
					Detained %	Through %
	-	-	-	-	-	-
3/4	418	418	0	0	0	100
3/8	380	380	0	0	0	100
4	440	440	0	0	0	100
8	434	434,24	0,24	0,24	0	100
16	358	358,00	0	0,24	0	100
30	401	401,96	0,96	1,2	1	99
50	293	293,80	0,8	2	2	98
100	390	395,80	5,8	7,8	8	92
200	288	291,39	3,39	11,19	11	89
pan	252	340,81	88,81	100	100	0
			100			

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Appendix E.1

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil

HYDROMETER

Time (minute)		2	5	15	30	60	250	1440
Grain Diameter (mm)		0,0400	0,0260	0,0150	0,0100	0,0074	0,0036	0,0015
Watch Correction	Rh	49,83	48,58	47,13	44,97	43,52	41,40	38,48
Hydrometer	KL	0,730	0,740	0,745	0,750	0,755	0,770	0,790
Correction	Gs	2,735	2,735	2,735	2,735	2,735	2,735	2,735
Specific Gravity	KG	0,82	0,82	0,82	0,82	0,82	0,82	0,82
Temperature Correction	LF	82,40	82,40	82,40	82,40	82,40	82,40	82,40
Solvent	KN	0,940	0,940	0,940	0,940	0,940	0,940	0,940
Grain Diameter Correction (mm) = d.KL.KN.KG		0,023	0,015	0,009	0,006	0,004	0,002	0,001
Hidrometer watch	dR	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3
After Correction	R=Rh+dR	49,528	48,281	46,832	44,671	43,216	41,101	38,184
Specific Gravity Constanta (a)		0,982	0,982	0,982	0,982	0,982	0,982	0,982
Smallest Percentage (P)		52,866	51,535	49,988	47,682	46,128	43,871	40,757
Through Percentage (%)		48,420	47,201	45,784	43,671	42,249	40,181	37,330

$$P = \frac{Ra}{W} \times 100\ \%$$

$$a = \frac{2{,}65 - 1{,}00}{2{,}65} \times \frac{Gs}{Gs - 1}$$

$$W = W_0 \times \frac{100}{100 + C} = 91{,}95 \text{ gram}$$

Temp = 28 ° C = 82.4 ° F

W_0 = 100 gram

PERCENTAGE HIGROSKOPIS

A. DRY AIR WEIGHT SOIL (W_1) = 60,28 Gram
B. DRY WEIGHT SOIL (OVEN) = 55,43 Gram
C. HYGROSCOPIC PERCENTAGE = $\frac{A - B}{B} \times 100\ \%$ = 8,75 %

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Appendix E.2

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 10%

HYDROMETER

Time (minute)		2	5	15	30	60	250	1440
Grain Diameter (mm)		0,0400	0,0260	0,0150	0,0100	0,0074	0,0036	0,0015
Watch Correction	Rh	51,69	50,17	49,16	47,14	46,64	43,61	42,10
Hydrometer	KL	0,730	0,740	0,745	0,750	0,755	0,770	0,790
Correction	Gs	2,735	2,735	2,735	2,735	2,735	2,735	2,735
Specific Gravity	KG	0,82	0,82	0,82	0,82	0,82	0,82	0,82
Temperature Correction	LF	82,40	82,40	82,40	82,40	82,40	82,40	82,40
Solvent	KN	0,940	0,940	0,940	0,940	0,940	0,940	0,940
Grain Diameter Correction (mm) = d.KL.KN.KG		0,023	0,015	0,009	0,006	0,004	0,002	0,001
Hidrometer watch	dR	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3
After Correction	R=Rh+dR	51,386	49,872	48,862	46,844	46,339	43,310	41,796
Specific Gravity Constanta (a)		0,982	0,982	0,982	0,982	0,982	0,982	0,982
Smallest Percentage (P)		54,672	53,061	51,986	49,839	49,302	46,079	44,468
Through Percentage (%)		49,226	47,776	46,808	44,875	44,391	41,490	40,039

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Appendix E.3

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 15%

HYDROMETER

Time (minute)		2	5	15	30	60	250	1440
Grain Diameter (mm)		0,0400	0,0260	0,0150	0,0100	0,0074	0,0036	0,0015
Watch Correction	Rh	47,07	46,58	45,13	44,17	42,72	40,30	37,40
Hydrometer	KL	0,720	0,730	0,734	0,758	0,760	0,770	0,776
Correction	Gs	2,547	2,547	2,547	2,547	2,547	2,547	2,547
Specific Gravity	KG	1,029	1,029	1,029	1,029	1,029	1,029	1,029
Temperature Correction	LF	82,40	82,40	82,40	82,40	82,40	82,40	82,40
Solvent	KN	0,940	0,940	0,940	0,940	0,940	0,940	0,940
Grain Diameter Correction (mm) = d.KL.KN.KG		0,028	0,018	0,011	0,007	0,005	0,003	0,001
Hidrometer watch	dR	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3
After Correction	R=Rh+dR	46,765	46,281	44,832	43,865	42,416	40,000	37,100
Specific Gravity Constanta (a)		1,025	1,025	1,025	1,025	1,025	1,025	1,025
Smallest Percentage (P)		51,904	51,367	49,759	48,686	47,077	44,396	41,177
Through Percentage (%)		46,465	45,984	44,544	43,583	42,144	39,743	36,862

$$P = \frac{Ra}{W} \times 100\ \%$$

$$a = \frac{2{,}65 - 1{,}00}{2{,}65} \times \frac{Gs}{Gs - 1}$$

$$W = W_0 \times \frac{100}{100 + C} = 92{,}35 \text{ gram}$$

Temp = 28 ° C = 82.4 ° F

W_0 = 100 gram

PERCENTAGE HIGROSKOPIS

A. DRY AIR WEIGHT SOIL (W_1)	=	49,57	Gram	
B. DRY WEIGHT SOIL (OVEN)	=	45,78	Gram	
C. HYGROSCOPIC PERCENTAGE = $\frac{A - B}{B} \times 100\ \%$	=	8,28	%	

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Appendix E.4

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 20%

HYDROMETER

Time (minute)		2	5	15	30	60	250	1440
Grain Diameter (mm)		0,0400	0,0260	0,0150	0,0100	0,0074	0,0036	0,0015
Watch Correction	Rh	44,53	43,55	42,02	41,01	40,00	36,98	32,95
Hydrometer	KL	0,810	0,816	0,820	0,830	0,832	0,844	0,867
Correction	Gs	2,505	2,505	2,505	2,505	2,505	2,505	2,505
Specific Gravity	KG	1,050	1,050	1,050	1,050	1,050	1,050	1,050
Temperature Correction	LF	82,40	82,40	82,40	82,40	82,40	82,40	82,40
Solvent	KN	0,940	0,940	0,940	0,940	0,940	0,940	0,940
Grain Diameter Correction (mm) = d.KL.KN.KG		0,032	0,021	0,012	0,008	0,006	0,003	0,001
Hidrometer watch	dR	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3
After Correction	R=Rh+dR	44,234	43,247	41,715	40,708	39,700	36,678	32,647
Specific Gravity Constanta (a)		1,036	1,036	1,036	1,036	1,036	1,036	1,036
Smallest Percentage (P)		49,518	48,413	46,698	45,571	44,442	41,059	36,547
Through Percentage (%)		43,977	42,996	41,473	40,471	39,469	36,465	32,457

$$P = \frac{Ra}{W} \times 100\ \%$$

$$a = \frac{2{,}65 - 1{,}00}{2{,}65} \times \frac{Gs}{Gs - 1}$$

$$W = W_0 \times \frac{100}{100 + C} = 92{,}59 \text{ gram}$$

Temp = 28 º C = 82.4 º F

W_0 = 100 gram

PERCENTAGE HYGROSCOPIC

A. DRY AIR WEIGHT SOIL (W_1)	=	58,67	Gram	
B. DRY WEIGHT SOIL (OVEN)	=	54,32	Gram	
C. HYGROSCOPIC PERCENTAGE = $\frac{A - B}{B} \times 100\ \%$	=	8,01	%	

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Appendix F.1

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil

COMPACTION TEST
STANDAR PROCTOR

Wet Soil Weight	gr	3000		3000		3000		3000		3000	
Water Content	%										
Addition Water	%										
Penambahan Air	ml	200		400		600		800		1000	
SAMPLE WEIGHT											
Soil Weight + Mold	gr	4845		4975		5065		5090		5045	
Mold Weight	gr	3495		3495		3495		3495		3495	
Wet Soil Weight	gr	1350		1480		1570		1595		1550	
Mold Volume	cc	864		864		864		864		864	
Wet Weight Volume	gr / cm³	1,563		1,713		1,817		1,846		1,794	
Dry Weight Volume	gr / cm³	1,336		1,379		1,382		1,321		1,218	
WATER CONTENT											
Wet Soil + Cup	gr	26,14	25,52	24,30	25,06	22,24	26,28	32,27	28,99	27,90	27,65
Dry Soil + Cup	gr	23,78	23,29	21,49	22,31	19,56	22,15	25,97	23,86	22,29	21,66
Water Weight	gr	2,36	2,23	2,81	2,75	2,68	4,13	6,30	5,13	5,61	5,99
Cup Weight	gr	9,72	10,28	10,01	10,86	10,97	9,13	10,26	10,85	10,24	9,21
Dry Weight Volume	gr	14,06	13,01	11,48	11,45	8,59	13,02	15,71	13,01	12,05	12,45
Water Content	%	16,79	17,14	24,48	24,02	31,20	31,72	40,10	39,43	46,56	48,11
Average	%	16,96		24,25		31,46		39,77		47,33	

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Appendix F.2

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 10%

COMPACTION TEST
STANDAR PROCTOR

Wet Soil Weight	gr	3000	3000	3000	3000	3000
Water Content	%					
Addition Water	%					
Penambahan Air	ml	200	400	600	800	1000

SAMPLE WEIGHT

Soil Weight + Mold	gr	3090	3270	3245	3230	3180
Mold Weight	gr	1780	1780	1780	1780	1780
Wet Soil Weight	gr	1310	1490	1465	1450	1400
Mold Volume	cc	864	864	864	864	864
Wet Weight Volume	gr / cm³	1,516	1,725	1,696	1,678	1,620
Dry Weight Volume	gr / cm³	1,196	1,292	1,235	1,156	1,071

WATER CONTENT

Wet Soil + Cup	gr	25,15	26,33	44,37	47,67	44,31	42,76	32,45	33,87	33,41	34,88
Dry Soil + Cup	gr	22,21	23,04	34,03	36,95	35,27	34,14	23,51	24,65	23,29	24,57
Water Weight	gr	2,94	3,29	10,34	10,72	9,04	8,62	8,94	9,22	10,12	10,31
Cup Weight	gr	11,00	11,00	4,00	4,00	11,00	11,00	4,00	4,00	4,00	4,00
Dry Weight Volume	gr	11,21	12,04	30,03	32,95	24,27	23,14	19,51	20,65	19,29	20,57
Water Content	%	26,23	27,33	34,43	32,53	37,25	37,25	45,82	44,65	52,46	50,12
Average	%	26,78		33,48		37,25		45,24		51,29	

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Appendix F.3

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 15%

COMPACTION TEST
STANDAR PROCTOR

Wet Soil Weight	gr	3000	3000	3000	3000	3000
Water Content	%					
Addition Water	%					
Penambahan Air	ml	200	400	600	800	1000

SAMPLE WEIGHT

Soil Weight + Mold	gr	3075	3195	3220	3150	3116
Mold Weight	gr	1780	1780	1780	1780	1780
Wet Soil Weight	gr	1295	1415	1440	1370	1336
Mold Volume	cc	864	864	864	864	864
Wet Weight Volume	gr / cm³	1,499	1,638	1,667	1,586	1,546
Dry Weight Volume	gr / cm³	1,162	1,212	1,169	1,110	1,022

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WATER CONTENT

Wet Soil + Cup	gr	25,65	26,33	44,57	47,17	45,61	43,96	32,45	33,47	33,41	34,88
Dry Soil + Cup	gr	22,21	23,04	34,03	35,95	35,27	34,14	23,91	24,65	23,29	24,57
Water Weight	gr	3,44	3,29	10,54	11,22	10,34	9,82	8,54	8,82	10,12	10,31
Cup Weight	gr	11,00	11,00	4,00	4,00	11,00	11,00	4,00	4,00	4,00	4,00
Dry Weight Volume	gr	11,21	12,04	30,03	31,95	24,27	23,14	19,91	20,65	19,29	20,57
Water Content	%	30,69	27,33	35,10	35,12	42,60	42,44	42,89	42,71	52,46	50,12
Average	%	29,01		35,11		42,52		42,80		51,29	

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Appendix F.4

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 20%

COMPACTION TEST
STANDAR PROCTOR

Wet Soil Weight	gr	3000	3000	3000	3000	3000
Water Content	%					
Addition Water	%					
Penambahan Air	ml	200	400	600	800	1000

SAMPLE WEIGHT

Soil Weight + Mold	gr	3040	3170	3215	3190	3070
Mold Weight	gr	1780	1780	1780	1780	1780
Wet Soil Weight	gr	1260	1390	1435	1410	1290
Mold Volume	cc	864	864	864	864	864
Wet Weight Volume	gr / cm³	1,458	1,609	1,661	1,632	1,493
Dry Weight Volume	gr / cm³	1,129	1,191	1,166	1,105	0,981

WATER CONTENT

Wet Soil + Cup	gr	25,85	26,93	44,57	47,17	45,61	43,96	33,45	34,47	33,41	34,88
Dry Soil + Cup	gr	22,21	23,04	34,03	35,95	35,27	34,14	23,91	24,65	25,29	26,57
Water Weight	gr	3,64	3,89	10,54	11,22	10,34	9,82	9,54	9,82	8,12	8,31
Cup Weight	gr	9,70	9,70	4,00	4,00	10,96	10,96	4,00	4,00	9,59	10,79
Dry Weight Volume	gr	12,51	13,34	30,03	31,95	24,31	23,18	19,91	20,65	15,70	15,78
Water Content	%	29,10	29,16	35,10	35,12	42,53	42,36	47,92	47,55	51,72	52,66
Average	%	29,13		35,11		42,45		47,74		52,19	

SOIL MECHANICS LABORATORY

CIVIL ENGINEERING DEPARTMENT, FACULTY OF ENGINEERING
SEBELAS MARET UNIVERSITY

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Appendix G.1.a

DIRECT SHEAR TEST

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil

Sample Data:

Wt of cup + UDS	=		gram
Wt of dry soil + cup	=		gram
Wt of cup	=		gram
Water content	=		%
γwet	=		kg/cm3
γdry	=		kg/cm3

Shear Speciment Data — ***Sample No. 1***

Area	=	34.21	cm2
Ht	=	1.85	cm
Volume	=	63.29	cm3
Normal Load	=	***0.80***	kg
Normal Stress	=	0.41	kg/cm2
Loading speed	=		cm/min
L R C	=	0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0.000	-	
	0.5	0.25	25	28.00	9.817	0.29	
	1	0.5	50	32.00	11.219	0.33	
	1.5	0.75	75	33.00	11.570	0.34	
	2	1	100	37.00	12.972	0.38	
	3	1.5	150	43.00	15.076	0.44	**0.779**
	4	2	200	48.00	16.829	0.49	
	6	3	300	56.00	19.634	0.57	
	8	4	400	61.00	21.387	0.63	
	10	5	500	68.00	23.841	0.70	
	12	6	600	76.00	26.646	**0.78**	

Appendix G.1.b

Sample Data:

Wt of cup + UDS	=	gram	**Shear Speciment Data**		***Sample No. 2***	
Wt of dry soil + cup	=	gram	Area	=	34.21	cm2
Wt of cup	=	gram	Ht	=	1.85	cm
Water content	=	%	Volume	=	63.29	cm3
γwet	=	kg/cm3	Normal Load	=	***1.60***	kg
γdry	=	kg/cm3	Normal Stress	=	0.83	kg/cm2
			Loading speed	=		cm/min
			L R C	=	0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	21.00	7.363	0.22	
	1	0.5	50	37.00	12.972	0.38	
	1.5	0.75	75	43.00	15.076	0.44	
	2	1	100	54.00	18.932	0.55	
	3	1.5	150	57.00	19.984	0.58	**0.963**
	4	2	200	62.00	21.737	0.64	
	6	3	300	74.00	25.944	0.76	
	8	4	400	80.00	28.048	0.82	
	10	5	500	87.00	30.502	0.89	
	12	6	600	94.00	32.956	**0.96**	

Appendix G.1.c

Sample Data:

			Shear Speciment Data			***Sample No.3***	
Wt of cup + UDS	=	gram	Area	=		34.21	cm2
Wt of dry soil + cup	=	gram	Ht	=		1.85	cm
Wt of cup	=	gram	Volume	=		63.29	cm3
Water content	=	%	Normal Load	=		***2.40***	kg
γwet	=	kg/cm3	Normal Stress	=		1.24	kg/cm2
γdry	=	kg/cm3	Loading speed	=			cm/min
			L R C	=		0.3506	kg/div

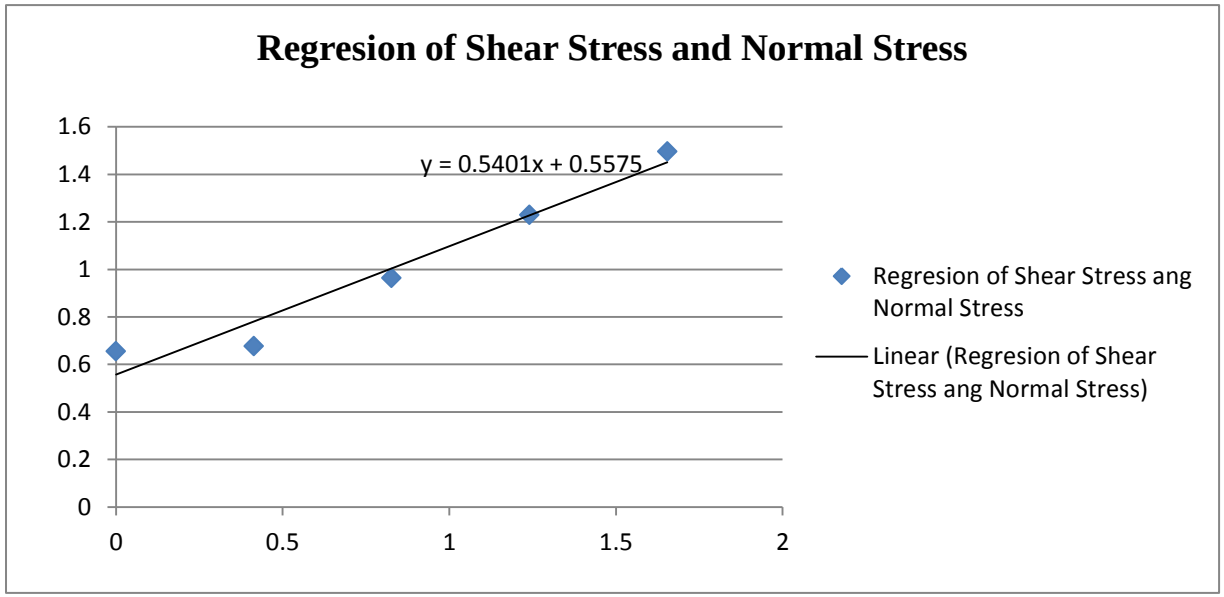
Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	29.50	10.343	0.30	
	1	0.5	50	40.00	14.024	0.41	
	1.5	0.75	75	49.50	17.355	0.51	
	2	1	100	58.50	20.510	0.60	
	3	1.5	150	66.50	23.315	0.68	**1.086**
	4	2	200	73.50	25.769	0.75	
	6	3	300	83.00	29.100	0.85	
	8	4	400	88.50	31.028	0.91	
	10	5	500	97.50	34.184	1.00	
	12	6	600	106.00	37.164	**1.09**	

Appendix G.1.d

Sample Data:

Wt of cup + UDS	=	gram	**Shear Speciment Data**			***Sample No. 4***	
Wt of dry soil + cup	=	gram	Area	=		34.21	cm2
Wt of cup	=	gram	Ht	=		1.85	cm2
Water content	=	%	Volume	=		63.29	cm3
γwet	=	kg/cm3	Normal Load	=		***3.20***	kg
γdry	=	kg/cm3	Normal Stress	=		1.65	kg/cm2
			Loading speed	=			cm/min
			L R C	=		0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	38.00	13.323	0.39	
	1	0.5	50	43.00	15.076	0.44	
	1.5	0.75	75	56.00	19.634	0.57	
	2	1	100	63.00	22.088	0.65	
	3	1.5	150	76.00	26.646	0.78	**1.209**
	4	2	200	85.00	29.801	0.87	
	6	3	300	92.00	32.255	0.94	
	8	4	400	97.00	34.008	0.99	
	10	5	500	108.00	37.865	1.11	
	12	6	600	118.00	41.371	**1.21**	



c = 0.656 Kg/cm^2

ϕ = 18.89 °

SOIL MECHANICS LABORATORY

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Appendix G.2.a

DIRECT SHEAR TEST

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 10%

Sample Data:

Wt of cup + UDS	=	gram	
Wt of dry soil + cup	=	gram	
Wt of cup	=	gram	
Water content	=	%	
γwet	=	kg/cm3	
γdry	=	kg/cm3	

Shear Speciment Data — ***Sample No. 1***

Area	=	34.21	cm2
Ht	=	1.85	cm
Volume	=	63.29	cm3
Normal Load	=	***0.80***	kg
Normal Stress	=	0.41	kg/cm2
Loading speed	=		cm/min
L R C	=	0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0.000	-	
	0.5	0.25	25	28.00	9.817	0.29	
	1	0.5	50	32.00	11.219	0.33	
	1.5	0.75	75	33.00	11.570	0.34	
	2	1	100	37.00	12.972	0.38	
	3	1.5	150	43.00	15.076	0.44	**0.676**
	4	2	200	48.00	16.829	0.49	
	6	3	300	54.00	18.932	0.55	
	8	4	400	59.00	20.685	0.60	
	10	5	500	64.00	22.438	0.66	
	12	6	600	66.00	23.140	**0.68**	

Appendix G.2.b

Sample Data:

			Shear Speciment Data			***Sample No. 2***	
Wt of cup + UDS	=	gram	Area	=		34.21	cm2
Wt of dry soil + cup	=	gram	Ht	=		1.85	cm
Wt of cup	=	gram	Volume	=		63.29	cm3
Water content	=	%	Normal Load	=		***1.60***	kg
γwet	=	kg/cm3	Normal Stress	=		0.83	kg/cm2
γdry	=	kg/cm3	Loading speed	=			cm/min
			L R C	=		0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	21.00	7.363	0.22	
	1	0.5	50	37.00	12.972	0.38	
	1.5	0.75	75	43.00	15.076	0.44	
	2	1	100	56.00	19.634	0.57	
	3	1.5	150	62.00	21.737	0.64	**0.963**
	4	2	200	75.00	26.295	0.77	
	6	3	300	89.00	31.203	0.91	
	8	4	400	94.00	32.956	**0.96**	
	10	5	500	94.00	32.956	**0.96**	
	12	6	600	94.00	32.956	**0.96**	

Appendix G.2.c

Sample Data:

			Shear Speciment Data			***Sample No.3***	
Wt of cup + UDS	=	gram	Area	=		34.21	cm2
Wt of dry soil + cup	=	gram	Ht	=		1.85	cm
Wt of cup	=	gram	Volume	=		63.29	cm3
Water content	=	%	Normal Load	=		***2.40***	kg
γwet	=	kg/cm3	Normal Stress	=		1.24	kg/cm2
γdry	=	kg/cm3	Loading speed	=			cm/min
			L R C	=		0.3506	kg/div

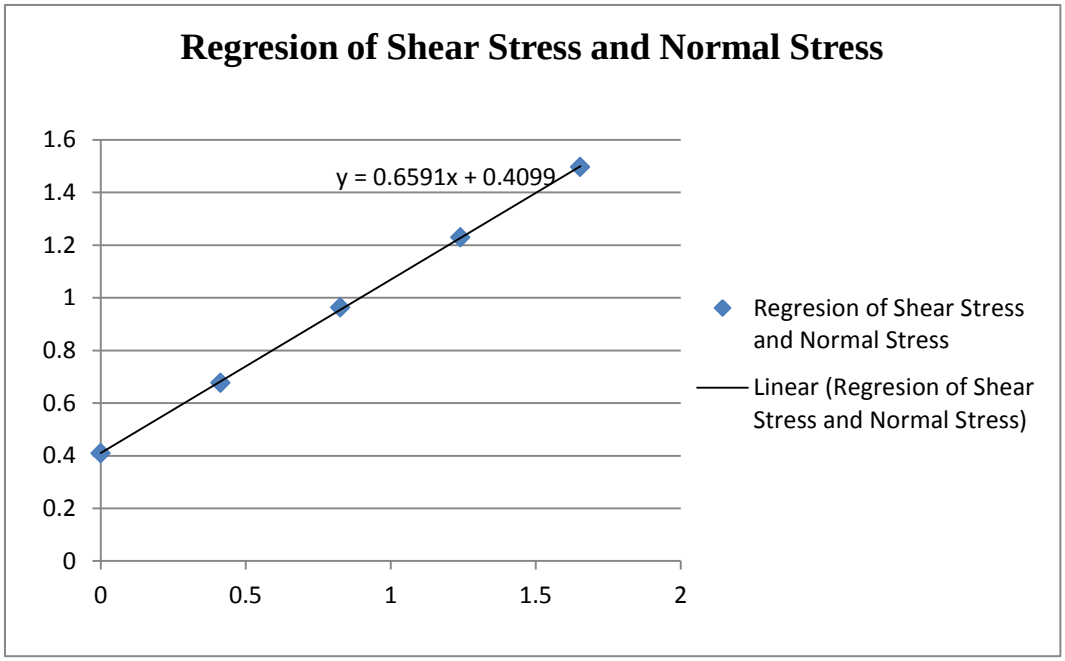
Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	29.50	10.343	0.30	
	1	0.5	50	40.00	14.024	0.41	
	1.5	0.75	75	49.50	17.355	0.51	
	2	1	100	66.50	23.315	0.68	
	3	1.5	150	78.50	27.522	0.80	**1.230**
	4	2	200	88.50	31.028	0.91	
	6	3	300	101.50	35.586	1.04	
	8	4	400	111.00	38.917	1.14	
	10	5	500	112.50	39.443	1.15	
	12	6	600	120.00	42.072	**1.23**	

Appendix G.2.d

Sample Data:

Wt of cup + UDS	=	gram	**Shear Speciment Data**			***Sample No. 4***
Wt of dry soil + cup	=	gram	Area	=	34.21	cm2
Wt of cup	=	gram	Ht	=	1.85	cm2
Water content	=	%	Volume	=	63.29	cm3
γwet	=	kg/cm3	Normal Load	=	***3.20***	kg
γdry	=	kg/cm3	Normal Stress	=	1.65	kg/cm2
			Loading speed	=		cm/min
			L R C	=	0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	38.00	13.323	0.39	
	1	0.5	50	43.00	15.076	0.44	
	1.5	0.75	75	56.00	19.634	0.57	
	2	1	100	77.00	26.996	0.79	
	3	1.5	150	95.00	33.307	0.97	**1.496**
	4	2	200	102.00	35.761	1.05	
	6	3	300	114.00	39.968	1.17	
	8	4	400	128.00	44.877	1.31	
	10	5	500	131.00	45.929	1.34	
	12	6	600	146.00	51.188	**1.50**	



c = 0.410 Kg/cm^2

ϕ = 33.40 °

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Appendix G.3.a

DIRECT SHEAR TEST

: Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 15%

Sample Data:

Wt of cup + UDS	=		gram
Wt of dry soil + cup	=		gram
Wt of cup	=		gram
Water content	=		%
γwet	=		kg/cm3
γdry	=		kg/cm3

Shear Speciment Data — ***Sample No. 1***

Area	=	34.21	cm2
Ht	=	1.85	cm
Volume	=	63.29	cm3
Normal Load	=	***0.80***	kg
Normal Stress	=	0.41	kg/cm2
Loading speed	=		cm/min
L R C	=	0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0.000	-	
	0.5	0.25	25	21.00	7.363	0.22	
	1	0.5	50	23.00	8.064	0.24	
	1.5	0.75	75	28.00	9.817	0.29	
	2	1	100	34.00	11.920	0.35	
	3	1.5	150	39.00	13.673	0.40	**0.707**
	4	2	200	43.00	15.076	0.44	
	6	3	300	51.00	17.881	0.52	
	8	4	400	57.00	19.984	0.58	
	10	5	500	64.00	22.438	0.66	
	12	6	600	69.00	24.191	**0.71**	

Appendix G.3.b

Sample Data:

Wt of cup + UDS	=	gram	**Shear Speciment Data**			***Sample No. 2***	
Wt of dry soil + cup	=	gram	Area	=	34.21	cm2	
Wt of cup	=	gram	Ht	=	1.85	cm	
Water content	=	%	Volume	=	63.29	cm3	
γwet	=	kg/cm3	Normal Load	=	***1.60***	kg	
γdry	=	kg/cm3	Normal Stress	=	0.83	kg/cm2	
			Loading speed	=		cm/min	
			L R C	=	0.3506	kg/div	

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	34.00	11.920	0.35	
	1	0.5	50	35.00	12.271	0.36	
	1.5	0.75	75	46.00	16.128	0.47	
	2	1	100	48.00	16.829	0.49	
	3	1.5	150	48.00	16.829	0.49	**0.902**
	4	2	200	62.00	21.737	0.64	
	6	3	300	76.00	26.646	0.78	
	8	4	400	79.00	27.697	0.81	
	10	5	500	82.00	28.749	0.84	
	12	6	600	88.00	30.853	**0.90**	

Appendix G.3.c

Sample Data:

			Shear Speciment Data			***Sample No.3***	
Wt of cup + UDS	=	gram	Area	=		34.21	cm2
Wt of dry soil + cup	=	gram	Ht	=		1.85	cm
Wt of cup	=	gram	Volume	=		63.29	cm3
Water content	=	%	Normal Load	=		***2.40***	kg
γwet	=	kg/cm3	Normal Stress	=		1.24	kg/cm2
γdry	=	kg/cm3	Loading speed	=			cm/min
			L R C	=		0.3506	kg/div

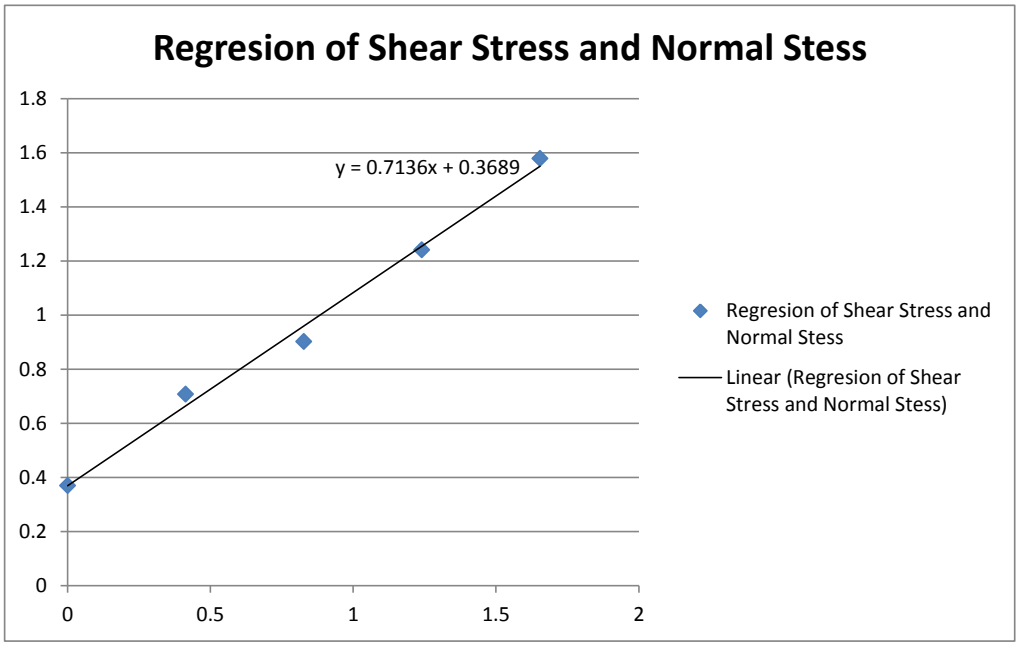
Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	46.00	16.128	0.47	
	1	0.5	50	56.50	19.809	0.58	
	1.5	0.75	75	65.50	22.964	0.67	
	2	1	100	74.50	26.120	0.76	
	3	1.5	150	80.50	28.223	0.82	**1.240**
	4	2	200	93.00	32.606	0.95	
	6	3	300	103.00	36.112	1.06	
	8	4	400	110.50	38.741	1.13	
	10	5	500	116.50	40.845	1.19	
	12	6	600	121.00	42.423	**1.24**	

Appendix G.3.d

Sample Data:

Wt of cup + UDS	=	gram	**Shear Speciment Data**			***Sample No. 4***	
Wt of dry soil + cup	=	gram	Area	=	34.21	cm2	
Wt of cup	=	gram	Ht	=	1.85	cm2	
Water content	=	%	Volume	=	63.29	cm3	
γwet	=	kg/cm3	Normal Load	=	***3.20***	kg	
γdry	=	kg/cm3	Normal Stress	=	1.65	kg/cm2	
			Loading speed	=		cm/min	
			L R C	=	0.3506	kg/div	

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	58.00	20.335	0.59	
	1	0.5	50	78.00	27.347	0.80	
	1.5	0.75	75	85.00	29.801	0.87	
	2	1	100	101.00	35.411	1.04	
	3	1.5	150	113.00	39.618	1.16	**1.578**
	4	2	200	124.00	43.474	1.27	
	6	3	300	130.00	45.578	1.33	
	8	4	400	142.00	49.785	1.46	
	10	5	500	151.00	52.941	1.55	
	12	6	600	154.00	53.992	**1.58**	



c = 0.369 Kg/cm^2

ϕ = 35.53 °

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Appendix G.4.a

DIRECT SHEAR TEST

Work : Final project
Soil : Ds. Bendo, Sukodono, Sragen
Sample : Native soil + Charcoal wood powder 20%

Sample Data:

Wt of cup + UDS	=	gram	
Wt of dry soil + cup	=	gram	
Wt of cup	=	gram	
Water content	=	%	
γwet	=	kg/cm3	
γdry	=	kg/cm3	

Shear Speciment Data — ***Sample No. 1***

Area	=	34.21	cm2
Ht	=	1.85	cm
Volume	=	63.29	cm3
Normal Load	=	***0.80***	kg
Normal Stress	=	0.41	kg/cm2
Loading speed	=		cm/min
L R C	=	0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0.000	-	
	0.5	0.25	25	22.00	7.713	0.23	
	1	0.5	50	22.00	7.713	0.23	
	1.5	0.75	75	23.00	8.064	0.24	
	2	1	100	30.00	10.518	0.31	
	3	1.5	150	42.00	14.725	0.43	**0.687**
	4	2	200	47.00	16.478	0.48	
	6	3	300	49.00	17.179	0.50	
	8	4	400	54.00	18.932	0.55	
	10	5	500	66.00	23.140	0.68	
	12	6	600	67.00	23.490	**0.69**	

Appendix G.4.b

Sample Data:

			Shear Speciment Data			
					Sample No. 2	
Wt of cup + UDS	=	gram	Area	=	34.21	cm2
Wt of dry soil + cup	=	gram	Ht	=	1.85	cm
Wt of cup	=	gram	Volume	=	63.29	cm3
Water content	=	%	Normal Load	=	***1.60***	kg
γwet	=	kg/cm3	Normal Stress	=	0.83	kg/cm2
γdry	=	kg/cm3	Loading speed	=		cm/min
			L R C	=	0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	14.00	4.908	0.14	
	1	0.5	50	14.00	4.908	0.14	
	1.5	0.75	75	16.00	5.610	0.16	
	2	1	100	27.00	9.466	0.28	
	3	1.5	150	31.00	10.869	0.32	**0.810**
	4	2	200	48.00	16.829	0.49	
	6	3	300	56.00	19.634	0.57	
	8	4	400	68.00	23.841	0.70	
	10	5	500	74.00	25.944	0.76	
	12	6	600	79.00	27.697	**0.81**	

Appendix G.4.c

Sample Data:

			Shear Speciment Data			***Sample No.3***	
Wt of cup + UDS	=	gram	Area	=		34.21	cm2
Wt of dry soil + cup	=	gram	Ht	=		1.85	cm
Wt of cup	=	gram	Volume	=		63.29	cm3
Water content	=	%	Normal Load	=		***2.40***	kg
γwet	=	kg/cm3	Normal Stress	=		1.24	kg/cm2
γdry	=	kg/cm3	Loading speed	=			cm/min
			L R C	=		0.3506	kg/div

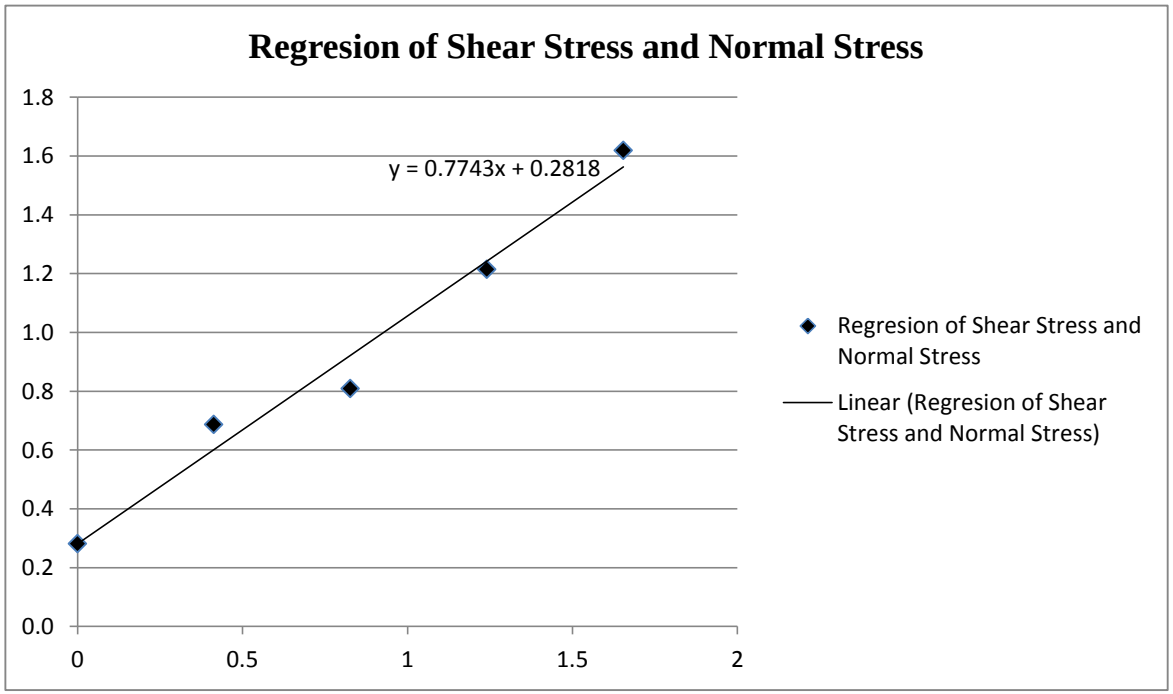
Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	29.50	10.343	0.30	
	1	0.5	50	31.00	10.869	0.32	
	1.5	0.75	75	32.00	11.219	0.33	
	2	1	100	38.50	13.498	0.39	
	3	1.5	150	47.00	16.478	0.48	**1.214**
	4	2	200	65.00	22.789	0.67	
	6	3	300	76.50	26.821	0.78	
	8	4	400	94.00	32.956	0.96	
	10	5	500	103.00	36.112	1.06	
	12	6	600	118.50	41.546	**1.21**	

Appendix G.4.d

Sample Data:

			Shear Speciment Data		***Sample No. 4***	
Wt of cup + UDS	=	gram	Area	=	34.21	cm2
Wt of dry soil + cup	=	gram	Ht	=	1.85	cm2
Wt of cup	=	gram	Volume	=	63.29	cm3
Water content	=	%	Normal Load	=	***3.20***	kg
γwet	=	kg/cm3	Normal Stress	=	1.65	kg/cm2
γdry	=	kg/cm3	Loading speed	=		cm/min
			L R C	=	0.3506	kg/div

Time	Elapsed time (minute)	Horiz. Disp. (mm)	Horiz. Dial Reading	Load Dial Reading (kg)	Shear Force (kg)	Shear Stress (kg/cm2)	Shear Stress at Failure (kg/cm2)
1	2	3	4	5	6	7	8
	0	0	0	0.00	0	-	
	0.5	0.25	25	45.00	15.777	0.46	
	1	0.5	50	48.00	16.829	0.49	
	1.5	0.75	75	48.00	16.829	0.49	
	2	1	100	50.00	17.530	0.51	
	3	1.5	150	63.00	22.088	0.65	**1.619**
	4	2	200	82.00	28.749	0.84	
	6	3	300	97.00	34.008	0.99	
	8	4	400	120.00	42.072	1.23	
	10	5	500	132.00	46.279	1.35	
	12	6	600	158.00	55.395	**1.62**	



c = 0.282 Kg/cm^2

ϕ = 37.77 °